



# Low Power Vco Design In Cmos

**Alice Wang, Benton Highsmith  
Calhoun, Anantha P. Chandrakasan**



## **Low Power Vco Design In Cmos:**

*Low Power VCO Design in CMOS* Marc Tiebout, 2006-01-25 This work covers the design of CMOS fully integrated low power low phase noise voltage controlled oscillators for telecommunication or datacommunication systems The need for low power is obvious as mobile wireless telecommunications are battery operated As wireless telecommunication systems use oscillators in frequency synthesizers for frequency translation the selectivity and signal to noise ratio of receivers and transmitters depend heavily on the low phase noise performance of the implemented oscillators Datacommunication systems need low jitter the time domain equivalent of low phase noise clocks for data detection and recovery The power consumption is less critical The need for multi band and multi mode systems pushes the high integration of telecommunication systems This is offered by sub micron CMOS featuring digital exibility The recent crisis in telecommunication clearly shows that mobile hand sets became mass market high volume consumer products where low cost is of prime importance This need for low cost products livens tremendously research towards CMOS alternatives for the bipolar or BiCMOS solutions in use today

Analysis and Design of Quadrature Oscillators Luis B. Oliveira, Jorge R. Fernandes, Igor M. Filanovsky, Chris J. M. Verhoeven, Manuel M. Silva, 2008-07-08 Modern RF receivers and transmitters require quadrature oscillators with accurate quadrature and low phase noise Existing literature is dedicated mainly to single oscillators and is strongly biased towards LC oscillators This book is devoted to quadrature oscillators and presents a detailed comparative study of LC and RC oscillators both at architectural and at circuit levels It is shown that in cross coupled RC oscillators both the quadrature error and phase noise are reduced whereas in LC oscillators the coupling decreases the quadrature error but increases the phase noise Thus quadrature RC oscillators can be a practical alternative to LC oscillators pecially when area and cost are to be minimized The main topics of the book are cross coupled LC quasi sinusoidal oscillators cross coupled RC relaxation oscillators a quadrature RC oscillator mixer and t integrator oscillators The effect of mismatches on the phase error and the phase noise are thoroughly investigated The book includes many experimental results obtained from different integrated circuit prototypes in the GHz range A structured design approach is followed a technology independent study with ideal blocks is performed initially and then the circuit level design is addressed This book can be used in advanced courses on RF circuit design In addition to post graduate students and lecturers this book will be of interest to design engineers and researchers in this area

Sub-threshold Design for Ultra Low-Power Systems Alice Wang, Benton Highsmith Calhoun, Anantha P. Chandrakasan, 2006-12-11 Based on the work of MIT graduate students Alice Wang and Benton Calhoun this book surveys the field of sub threshold and low voltage design and explores such aspects of sub threshold circuit design as modeling logic and memory circuit design One important chapter of the book is dedicated to optimizing energy dissipation a key metric for energy constrained designs This book also includes invited chapters on the subject of analog sub threshold circuits

**Transformer-Based Design Techniques for Oscillators and Frequency Dividers** Howard Cam Luong, Jun

Yin,2015-10-07 This book provides in depth coverage of transformer based design techniques that enable CMOS oscillators and frequency dividers to achieve state of the art performance Design optimization and measured performance of oscillators and frequency dividers for different applications are discussed in detail focusing on not only ultra low supply voltage but also ultra wide frequency tuning range and locking range This book will be an invaluable reference for anyone working or interested in CMOS radio frequency or mm Wave integrated circuits and systems      **Intelligent Electronic Devices**

Teen-Hang Meen,Wenbing Zhao,Cheng-Fu Yang,2020-05-20 In a modern technological society electronic engineering and design innovations are both academic and practical engineering fields that involve systematic technological materialization through scientific principles and engineering designs Engineers and designers must work together with a variety of other professionals in their quest to find systems solutions to complex problems Rapid advances in science and technology have broadened the horizons of engineering while simultaneously creating a multitude of challenging problems in every aspect of modern life Current research is interdisciplinary in nature reflecting a combination of concepts and methods that often span several areas of mechanics mathematics electrical engineering control engineering and other scientific disciplines In addition the 2nd IEEE International Conference on Knowledge Innovation and Invention 2019 IEEE ICKII 2019 was held in Seoul South Korea on 12 15 July 2019 This book Intelligent Electronic Devices includes 13 excellent papers form 260 papers presented in this conference about intelligent electronic devices The main goals of this book were to encourage scientists to publish their experimental and theoretical results in as much detail as possible and to provide new scientific knowledge relevant to the topics of electronics      **Advanced Microwave Circuits and Systems**

Vitaliy Zhurbenko,2010-04-01 This book is based on recent research work conducted by the authors dealing with the design and development of active and passive microwave components integrated circuits and systems It is divided into seven parts In the first part comprising the first two chapters alternative concepts and equations for multiport network analysis and characterization are provided A thru only de embedding technique for accurate on wafer characterization is introduced The second part of the book corresponds to the analysis and design of ultra wideband low noise amplifiers LNA      Performance Optimization Techniques in Analog, Mixed-Signal, and Radio-Frequency Circuit Design

Fakhfakh, Mourad,Tlelo-Cuautle, Esteban,Fino, Maria Helena,2014-10-31 Improving the performance of existing technologies has always been a focal practice in the development of computational systems However as circuitry is becoming more complex conventional techniques are becoming outdated and new research methodologies are being implemented by designers Performance Optimization Techniques in Analog Mixed Signal and Radio Frequency Circuit Design features recent advances in the engineering of integrated systems with prominence placed on methods for maximizing the functionality of these systems This book emphasizes prospective trends in the field and is an essential reference source for researchers practitioners engineers and technology designers interested in emerging research and techniques in the performance optimization of different circuit designs      *Designing Bipolar Transistor Radio*

*Frequency Integrated Circuits* Allen A. Sweet, 2007-12-01 If you're looking for an in depth and up to date understanding bipolar transistor RFIC design this practical resource is a smart choice Unlike most books on the market that focus on GaAs MESFET or silicon CMOS process technology this unique volume is dedicated exclusively to RFIC designs based on bipolar technology Until now critical GaAs HBT and SiGe HBT process technologies have been largely neglected in reference books This book fills this gap offering you a detailed treatment of this increasingly important topic You discover a wide range of circuit topologies that are optimized for maximum performance with bipolar devices From discussions of key applications Bluetooth UWB GPS WiMax and architectures to in depth coverage of fabrication technologies and amplifier design to a look at performance tradeoffs and production costs this book arms you with complete design know how for your challenging work in the field

**Practical Guide to RF-MEMS** Jacopo Iannacci, 2013-08-12 Closes the gap between hardcore theoretical and purely experimental RF MEMS books The book covers from a practical viewpoint the most critical steps that have to be taken in order to develop novel RF MEMS device concepts Prototypical RF MEMS devices both including lumped components and complex networks are presented at the beginning of the book as reference examples and these are then discussed from different perspectives with regard to design simulation packaging testing and post fabrication modeling Theoretical concepts are introduced when necessary to complement the practical hints given for all RF MEMS development stages Provides researchers and engineers with invaluable practical hints on how to develop novel RF MEMS device concepts Covers all critical steps dealing with design simulation optimization characterization and fabrication of MEMS for radio frequency applications Addresses frequently disregarded issues explicitly treating the hard to predict interplay between the three dimensional device structure and its electromagnetic functionality Bridges theory and experiment fundamental concepts are introduced with the application in mind and simulation results are validated against experimental results Appeals to the practice oriented R D reader design and simulation examples are based on widely known software packages such as ANSYS and the hardware description language Verilog

**Trade-Offs in Analog Circuit Design** Chris Toumazou, George S. Moschytz, Barrie Gilbert, 2007-05-08 As the frequency of communication systems increases and the dimensions of transistors are reduced more and more stringent performance requirements are placed on analog circuits This is a trend that is bound to continue for the foreseeable future and while it does understanding performance trade offs will constitute a vital part of the analog design process It is the insight and intuition obtained from a fundamental understanding of performance conflicts and trade offs that ultimately provides the designer with the basic tools necessary for effective and creative analog design Trade offs in Analog Circuit Design which is devoted to the understanding of trade offs in analog design is quite unique in that it draws together fundamental material from and identifies interrelationships within a number of key analog circuits The book covers ten subject areas Design methodology Technology General Performance Filters Switched Circuits Oscillators Data Converters Transceivers Neural Processing and Analog CAD Within these subject areas it deals with a wide diversity of trade

offs ranging from frequency dynamic range and power gain bandwidth speed dynamic range and phase noise to tradeoffs in design for manufacture and IC layout The book has by far transcended its original scope and has become both a designer's companion as well as a graduate textbook An important feature of this book is that it promotes an intuitive approach to understanding analog circuits by explaining fundamental relationships and in many cases providing practical illustrative examples to demonstrate the inherent basic interrelationships and trade offs Trade offs in Analog Circuit Design draws together 34 contributions from some of the world's most eminent analog circuits and systems designers to provide for the first time a comprehensive text devoted to a very important and timely approach to analog circuit design

**Microwave Circuits for 24 GHz Automotive Radar in Silicon-based Technologies** Vadim Issakov, 2010-08-05 There are continuous efforts focussed on improving road traffic safety worldwide Numerous vehicle safety features have been invented and standardized over the past decades Particularly interesting are the driver assistance systems since these can considerably reduce the number of accidents by supporting drivers perception of their surroundings Many driver assistance features rely on radar based sensors Nowadays the commercially available automotive front end sensors are comprised of discrete components thus making the radar modules highly priced and suitable for integration only in premium class vehicles Realization of low cost radar front end circuits would enable their implementation in inexpensive economy cars considerably contributing to traffic safety Cost reduction requires high level integration of the microwave front end circuitry specifically analog and digital circuit blocks co located on a single chip Recent developments of silicon based technologies e.g CMOS and SiGe C bipolar make them suitable for realization of microwave sensors Additionally these technologies offer the necessary integration capability However the required output power and temperature stability necessary for automotive radar sensor products have not yet been achieved in standard digital CMOS technologies On the other hand SiGe bipolar technology offers excellent high frequency characteristics and necessary output power for automotive applications but has lower potential for realization of digital blocks than CMOS

*International Conference on Advanced Computing Networking and Informatics* Raj Kamal, Michael Henshaw, Pramod S. Nair, 2018-11-27 The book comprises selected papers presented at the International Conference on Advanced Computing Networking and Informatics ICANI 2018 organized by Medi Caps University India It includes novel and original research work on advanced computing networking and informatics and discusses a wide variety of industrial engineering and scientific applications of the emerging techniques in the field of computing and networking

*Recent Trends in Electronics and Communication* Amit Dhawan, Vijay Shanker Tripathi, Karm Veer Arya, Kshirasagar Naik, 2021-12-13 This book comprises select proceedings of the International Conference on VLSI Communication and Signal processing VCAS 2020 The contents are broadly divided into three topics VLSI Communication and Signal Processing The book focuses on the latest innovations trends and challenges encountered in the different areas of electronics and communication especially in the area of microelectronics and VLSI design communication systems and networks and image

and signal processing It also offers potential solutions and provides an insight into various emerging areas such as Internet of Things IoT System on a Chip SoC Sensor Networks underwater and underground communication networks etc This book will be useful for academicians and professionals alike      **Advanced Frequency Synthesis by Phase Lock** William F.

Egan,2011-10-07 The latest frequency synthesis techniques including sigma delta Diophantine and all digital Sigma delta is a frequency synthesis technique that has risen in popularity over the past decade due to its intensely digital nature and its ability to promote miniaturization A continuation of the popular Frequency Synthesis by Phase Lock Second Edition this timely resource provides a broad introduction to sigma delta by pairing practical simulation results with cutting edge research Advanced Frequency Synthesis by Phase Lock discusses both sigma delta and fractional n the still in use forerunner to sigma delta employing Simulink models and detailed simulations of results to promote a deeper understanding After a brief introduction the book shows how spurs are reproduced at the synthesizer output by the basic process and different methods for overcoming them It investigates how various defects in sigma delta synthesis contribute to spurs or noise in the synthesized signal Synthesizer configurations are analyzed and it is revealed how to trade off the various noise sources by choosing loop parameters Other sigma delta synthesis architectures are then reviewed The Simulink simulation models that provided data for the preceding discussions are described providing guidance in making use of such models for further exploration Next another method for achieving wide loop bandwidth simultaneously with finer resolution the Diophantine Frequency Synthesizer is introduced Operation at extreme bandwidths is also covered further describing the analysis of synthesizers that push their bandwidths close to the sampling frequency limit Lastly the book reviews a newly important technology that is poised to become widely used in high production consumer electronics all digital frequency synthesis Detailed appendices provide in depth discussion on various stages of development and many related resources are available for download including Simulink models MATLAB scripts spreadsheets and executable programs All these features make this authoritative reference ideal for electrical engineers who want to achieve an understanding of sigma delta frequency synthesis and an awareness of the latest developments in the field      **Microelectronics, Electromagnetics and Telecommunications** Ganapati Panda, Suresh

Chandra Satapathy, Birendra Biswal, Ramesh Bansal, 2018-11-02 The book discusses the latest developments and outlines future trends in the fields of microelectronics electromagnetics and telecommunication It contains original research works presented at the International Conference on Microelectronics Electromagnetics and Telecommunication ICMEET 2018 organised by GVP College of Engineering A Andhra Pradesh India The respective papers were written by scientists research scholars and practitioners from leading universities engineering colleges and R D institutes from all over the world and share the latest breakthroughs in and promising solutions to the most important issues facing today's society      *Phaselock Techniques* Floyd M. Gardner, 2005-07-25 A greatly revised and expanded account of phaselock technology The Third Edition of this landmark book presents new developments in the field of phaselock loops some of which have never been published

until now Established concepts are reviewed critically and recommendations are offered for improved formulations The work reflects the author s own research and many years of hands on experience with phaselock loops Reflecting the myriad of phaselock loops that are now found in electronic devices such as televisions computers radios and cell phones the book offers readers much new material including Revised and expanded coverage of transfer functions Two chapters on phase noise Two chapters examining digital phaselock loops A chapter on charge pump phaselock loops Expanded discussion of phase detectors and of oscillators A chapter on anomalous phaselocking A chapter on graphical aids including Bode plots root locus plots and Nichols charts As in the previous editions the focus of the book is on underlying principles which remain valid despite technological advances Extensive references guide readers to additional information to help them explore particular topics in greater depth Phaselock Techniques Third Edition is intended for practicing engineers researchers and graduate students This critically acclaimed book has been thoroughly updated with new information and expanded for greater depth

*VLSI-SoC: Forward-Looking Trends in IC and Systems Design* Jose L. Ayala,David Atienza Alonso,Ricardo Reis,2012-02-24 This book contains extended and revised versions of the best papers presented at the 18th IFIP WG 10 5 IEEE International Conference on Very Large Scale Integration VLSI SoC 2010 held in Madrid Spain in September 2010 The 14 papers included in the book were carefully reviewed and selected from the 52 full papers presented at the conference The papers cover a wide variety of excellence in VLSI technology and advanced research They address the current trend toward increasing chip integration and technology process advancements bringing about stimulating new challenges both at the physical and system design levels as well as in the test of theses systems *Microcontrollers in Practice* Ioan Susnea,Marian Mitescu,2005-07-06 Stressing common characteristics and real applications of the most used microcontrollers this practical guide provides readers with hands on knowledge of how to implement three families of microcontrollers HC11 AVR and 8051 Unlike the rest of the ocean of literature on individual chips Microcontrollers in Practice supplies side by side comparisons and an overview that treats the systems as resources available for implementation Packed with hundreds of practical examples and exercises to foster mastery of concepts and details the guide also includes several extended projects By treating the less expensive 8 bit and RISC microcontrollers this information dense manual equips students and home experimenters with the know how to put these devices into operation *Bonding in Microsystem Technology* Jan A. Dziuban,2007-01-30 This is the first compendium on silicon glass microsystems made by deep wet etching and the first book with a detailed description of bonding techniques used in microsystem technology Technological results presented in the book have been tested experimentally by the author and his team and can be utilized in day to day laboratory practice Special attention has been paid to the highest level of accessibility of the book by students *Microwave Circuit Design Using Linear and Nonlinear Techniques* George D. Vendelin,Anthony M. Pavio,Ulrich L. Rohde,2005-10-03 The ultimate handbook on microwave circuit design with CAD Full of tips and insights from seasoned industry veterans Microwave Circuit



Design offers practical proven advice on improving the design quality of microwave passive and active circuits while cutting costs and time Covering all levels of microwave circuit design from the elementary to the very advanced the book systematically presents computer aided methods for linear and nonlinear designs used in the design and manufacture of microwave amplifiers oscillators and mixers Using the newest CAD tools the book shows how to design transistor and diode circuits and also details CAD s usefulness in microwave integrated circuit MIC and monolithic microwave integrated circuit MMIC technology Applications of nonlinear SPICE programs now available for microwave CAD are described State of the art coverage includes microwave transistors HEMTs MODFETs MESFETs HBTs and more high power amplifier design oscillator design including feedback topologies phase noise and examples and more The techniques presented are illustrated with several MMIC designs including a wideband amplifier a low noise amplifier and an MMIC mixer This unique one stop handbook also features a major case study of an actual anticollision radar transceiver which is compared in detail against CAD predictions examples of actual circuit designs with photographs of completed circuits and tables of design formulae

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